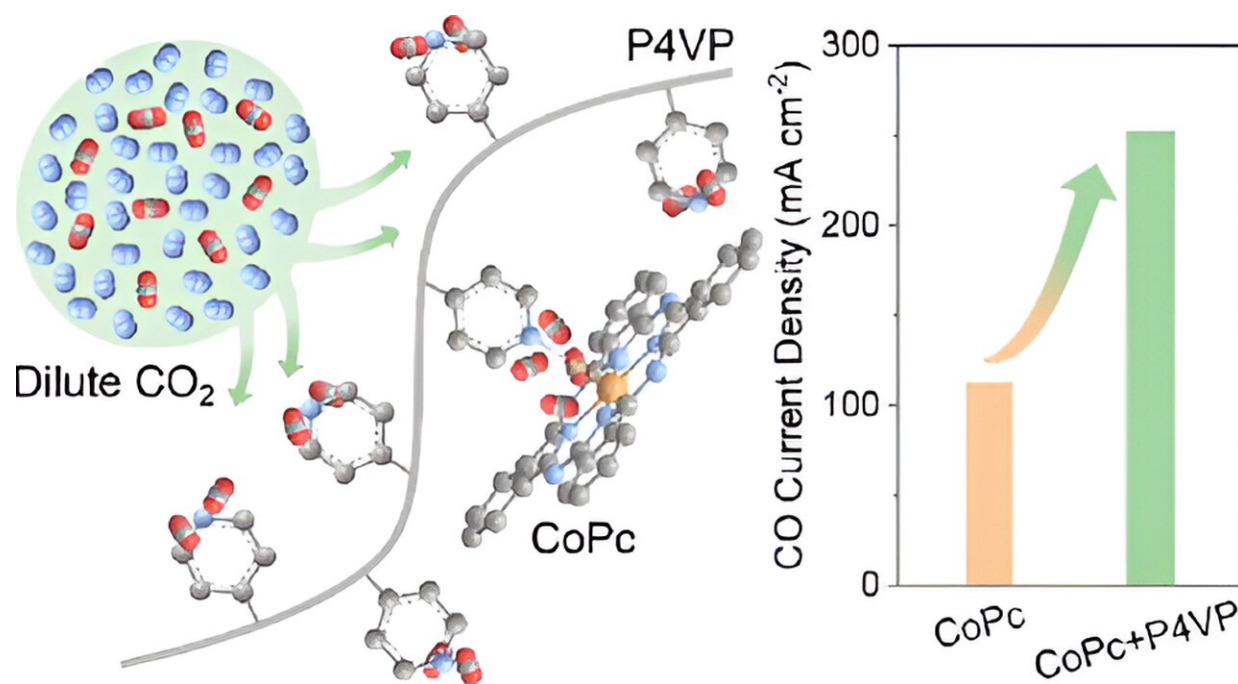


New strategy boosts direct electrolysis of dilute carbon dioxide

March 5 2024



Graphical abstract. Credit: *ACS Energy Letters* (2024). DOI: 10.1021/acsenerylett.3c02812

Converting carbon dioxide (CO₂) from industrial point sources to chemicals and fuels utilizing renewable energy can help to tackle the climate crisis. CO₂ electrolysis is one promising route.

Previous studies were generally performed with pure or highly

concentrated CO₂ feeds, while the CO₂ concentration in [flue gas](#) from the combustion of fossil fuels was very low, typically from 5% to 15%. The energy and [capital costs](#) associated with capturing and purifying CO₂ from flue gas point sources are very high. The direct utilization of industrial flue gas bypassing the capture and purification steps for producing pure CO₂ feeds is still challenging.

Recently, a research team led by Profs. Wang Guoxiong and Gao Dunfeng from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS), in collaboration with Prof. An Qingda from the Dalian Polytechnic University, have proposed a molecular enhancement strategy for direct [electrolysis](#) of dilute CO₂ to CO. This study was published in [ACS Energy Letters](#).

To deal with the unfavorable mass transport, reaction thermodynamics, and kinetics of direct electrolysis of dilute CO₂, the researchers constructed reaction microenvironment surrounding catalytically [active sites](#) by molecularly modifying CoPc electrodes with a poly(4-vinylpyridine) (P4VP) molecule. The formed reaction microenvironment effectively integrated the capture and conversion of CO₂ from dilute feed streams.

With a home-made alkaline membrane electrode assembly (MEA) electrolyzer, the researchers obtained a remarkable CO partial current density of 252 mA cm⁻² with a CO Faradaic efficiency of 90% under the dilute feed with a typical CO₂ concentration (10%) in flue gas, which was 2.24-fold higher than that of bare CoPc electrode.

Physicochemical and electrochemical structural characterization results indicated that the abundant pyridine groups of the P4VP modifier improved sequentially the physical adsorption and chemical activation of CO₂ over Co sites of CoPc catalysts, resulting in the impressive performance for direct electrolysis of dilute CO₂ to CO.

This molecular enhancement strategy, with further precise control in catalyst structures and reaction microenvironments, will hold great promise for the direct electrolysis of industrial flue gas and the selective production of multicarbon chemicals such as ethylene.

More information: Bingyu Chen et al, Molecular Enhancement of Direct Electrolysis of Dilute CO₂, *ACS Energy Letters* (2024). [DOI: 10.1021/acsenergylett.3c02812](https://doi.org/10.1021/acseenergylett.3c02812)

Provided by Chinese Academy of Sciences

Citation: New strategy boosts direct electrolysis of dilute carbon dioxide (2024, March 5)
retrieved 27 April 2024 from
<https://phys.org/news/2024-03-strategy-boosts-electrolysis-dilute-carbon.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.